FERTILIZATION IN THE BALDWIN APPLE, A TRIPLOID VARIETY

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THE DATA presented in Table I were obtained by studying sectioned root-tips from germinating seeds of the Baldwin apple. Several hundred seeds were placed in a box mixed with well moistened peat and frozen in a refrigerator for more than two months, from 1/9/34 to 3/19/34. They were then planted in soil in a flat. The seeds began to germinate during the latter part of March and one primary root-tip from each individual seed was cut and fixed in Lewitzky's solution. Four separate collections were made, 3/30/34, 4/2/34, 4/3/34 and 4/18/34. Fourteen seeds were analyzed from the collection of 3/30/34, 41 from that of 4/2/34, 45 from that of 4/3/34 and 36 from that of 4/18/34. Each root-tip was numbered and each group was recorded separately. Studying each group separately, no appreciable difference in the distribution of chromosome numbers was found, indicating that there was no segregation of chromosome numbers due to difference in seeds germinating at different times. Moffett (1931) has analyzed the somatic chromosome numbers of 32 seedlings obtained from four different 3n $\times$ 2n crosses and has found 10 seedlings having 41 chromosomes, other seedlings sharply varying from this number. Based on this observation he remarks that "41 chromosome number is the secondary diploid number (thirty-four). It is to be imputed that the high frequency of seedlings with 41 chromosomes is due to the greater viability of the 17 + 7 gametes in the triploid rather than to their zygotic viability, since seedlings having other chromosome numbers are frequently more vigorous than the 41 type."

Moffett has observed secondary pairing in the meiotic metaphase chromosomes of all the diploid types of the Pomoideae, forming sexivalent and quadrivalent groups and in extreme cases seven groups — three sexivalents and four quadrivalents. Because of this and the fact that he found more seedlings with 41 chromosomes than with other numbers, he has concluded that the 34 chromosomes of the diploid Pomoideae are of seven types, of which four are presented four times and three are presented six times, and that the haploid number 17 is a secondary basic number of 7, the ancestral basic number. A critique of this point of view is presented by Sax (1933).

At Dr. Karl Sax's suggestion the present writer examined the somatic number of chromosomes from 136 germinating seeds. Of these seeds 130 showed numbers ranging from 35 to 51 (Table I) and six seeds had the following numbers: 1 = 53, 1 = 57, 1 = 58, 1 = 59, 1 = 62, and 1 = 65 chromosomes (these are not included in the table). Here we notice that the class with 40 chromosomes is higher than the class with 41 chromosomes. The distribution here recorded is quite random and does not suggest that a gamete with 17 + 7 chromosomal combination has any advantage over the other combinations. Therefore, the fact that the class 41 singly is not larger than other classes, but conforms quite nearly to the expectation on the basis of normal distribution, invalidates Moffett's theory that a 17 + 7 chromosomal combination is more viable than others. The only peculiarity observed in this table is that the class with 39 chromosomes has only 9 seeds, fewer than expected, in which case perhaps for some reason some eggs with 22 chromosomes were either too few or failed to be fertilized.

TABLE I

CHROMOSOME DISTRIBUTION IN BALDWIN APPLE SEEDS

Chromosome number in seeds	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Number of seeds	-	1	3	2	16	9	24	20	16	13	10	6	4	1	2	-	-	3

Statistical data: Mean = 41.36 ± 0.173; σ = 2.93 ± 0.122; C.V. = 7.09 ± 0.296.

Pollen germination in the Baldwin apple is about 11–12% (Crane and Lawrence, 1930). By making breeding tests Sax (1922) has shown that the Baldwin is self sterile in Maine. The data presented here are from seeds of fruit set by open pollination. If the seeds had resulted from self pollination or cross pollination with another triploid form, the class center should have been around 51 and not, as in the table, far below this and with only five seeds above it. This strongly indicates that the Baldwin apple is self sterile in Massachusetts as well as in Maine and that it is easily cross fertile with diploid varieties. In this case, over 95% of the seeds must have resulted from pollination with haploid gametes from diploid varieties. The six seeds probably were the result of fertilization of eggs that contained more than 34 chromosomes which may have been due to restricted reduction division when at the first metaphase chromosomes fail to reduce and the great majority

of chromosomes go into resting stage again, while a few form small microcytes. Such cases were observed in *Rhoeo discolor* when treated with cold or heat. The fact that there were only three seeds with 51 chromosomes and none immediately below makes remote the probability of the six seeds with higher numbers having resulted from pollination with another triploid variety. On the basis of 3n × 3n cross with the union of gametes with 25 ± chromosomes, seeds with chromosomes ranging around 51 as a central point should have been numerous which obviously is not the case.

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